# Introduction

The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP), is charged with the mission of verifying that the SRS programs are adequate to detect impacts on the public health and the environment. The ESOP independently evaluates the SRS non-regulatory environmental monitoring programs through an established multi-media network on and around the site. The environmental monitoring data generated provides direct information about the concentrations of radionuclides in the air, water, vegetation, and foods in the vicinity of the SRS. Information gathered from these efforts also helps the ESOP support emergency response activities in the event of an unplanned release of radioactive materials; educate the public on monitoring activities around the SRS; and provide recommendations to the DOE-SR for improving their environmental monitoring programs.

The ESOP employs 11 media specific projects for monitoring the environment for releases by the SRS. These monitoring projects include Radiological Atmospheric Quality Adjacent to SRS; Ambient Groundwater Quality Adjacent to the SRS; Drinking Water Quality Monitoring; Radiological Surface Water and Sediment Surveillance; Non-Radiological Surface Water and Sediment Monitoring; Radiological Surveillance of Surface Soils On and Adjacent to the SRS; Radiological Monitoring of Terrestrial Vegetation On and Adjacent to SRS; Radiological Monitoring of Dairy Milk; Radiological Fish Monitoring Associated with Savannah River; Radiological Game Animal Monitoring Adjacent to SRS; Oversight Monitoring and Support Activities.

ESOP has identified additional field oversight projects to verify the validity and effectiveness of monitoring activities at Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites. Additional projects are being considered to provide information for new proposed SRS facilities, fill data gaps, and evaluate other SRS non-regulatory monitoring programs. This improvement in monitoring capability indicates a commitment by the SCDHEC to fulfill its mission to protect public health and the environment, and reinforces the DOE-SR's commitment to improving open communication and cooperation with host states.

This 2000 ESOP Data Report provides a summary of the ESOP environmental monitoring results generated during the 2000 calendar year. The data and information presented are in accordance with the ESOP's Standard Operating Procedures and project monitoring plans. Complete data tables are located in the appendices. Copies of environmental reports may be obtained by contacting:

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| | |
|---|---|
| **CERCLA** | Comprehensive Environmental Response, Compensation and Liability Act |
| **Cs-137** | Cesium-137 |
| **DOE** | US Department of Energy |
| **DOE-SR** | US Department of Energy at Savannah River Site |
| **EMS** | Environmental Monitoring Section of the Environmental Protection Department (Westinghouse Savannah River Company) |
| **EPA** | US Environmental Protection Agency |
| **ESOP** | Environmental Surveillance and Oversight Program |
| **ETF** | Effluent Treatment Facility |
| **FY** | Fiscal Year |
| **GIS** | Geographic Information System |
| **LLD** | Lower Limit of Detection |
| **LSD** | Lower Savannah District |
| **MCL** | Maximum Contamination Level |
| **Pu-238, -239, -240** | Plutonium-238, -239, -240 |
| **RBA** | Risk Based Activity |
| **REMD** | Radiological Environmental Monitoring Division (SCDHEC) |
| **SCDHEC** | South Carolina Department of Health and Environmental Control |
| **SRS** | Savannah River Site |
| **TCLP** | Toxicity Characteristic Leaching Procedure |
| **TLD** | Thermoluminescent Dosimeter |
| **TSP** | Total Suspended Particulates |
| **WSRC** | Westinghouse Savannah River Company |

### Units of Measurement

| | | | |
|---|---|---|---|
| Celsius | C | picocurie | pCi |
| cubic centimeters | cc | Liter | L |
| gram | g | | |
| microcurie | μCi | | |
| microgram | μg | | |
| millirem | mrem | | |
| cubic meter | $m^3$ | | |
| Curie | Ci | | |

ESOP provides monitoring of atmospheric media on a routine basis to measure radionuclide concentrations in the environment; verify that levels of radionuclides are within reported levels; and identify trends. Radiological atmospheric monitoring sites are located to provide spatial coverage of the project area where public exposure could occur.

SCDHEC air monitoring capabilities in 2000 included air monitoring stations with capacity for sample collection of glass fiber filters, precipitation, silica gel columns, and thermoluminescent dosimeters (TLDs) (**Map 1**). The glass fiber filters were used to collect total airborne particulates. Particulates were screened weekly for gross alpha, gross beta, and gamma-emitting radionuclides. October, November, and December glass fiber filters were composited and analyzed for selected isotopes. Precipitation, when present, was sampled and analyzed weekly for tritium. Silica gel distillates of atmospheric moisture were analyzed every other week for tritium. TLDs were collected and analyzed every three months for ambient beta/gamma levels. Data is reported for first, second, and third quarters of 2000. Because contract laboratory problems compromised the fourth quarter data, it is not included in this report.

All ESOP data collected confirmed historically reported DOE-SR values for radionuclides in the ambient environment at the SRS boundary (**Appendix A**). ESOP air and precipitation tritium data were consistently lower than the DOE-SR measured and modeled values, although within the same order-of-magnitude. One potential explanation for the slight decrease in ESOP values is that some "perimeter" monitoring locations are located in adjacent population centers, approximately two miles from the legal property line, but used as "perimeter" monitoring locations to provide a point of comparison. **Figures 1,2,3** illustrate the trending of gross beta, beta/gamma and tritium values for SCDHEC and DOE-SR as measured at the SRS perimeter.

**Figure 1. Average Gross Beta for TSP at the SRS Perimeter**

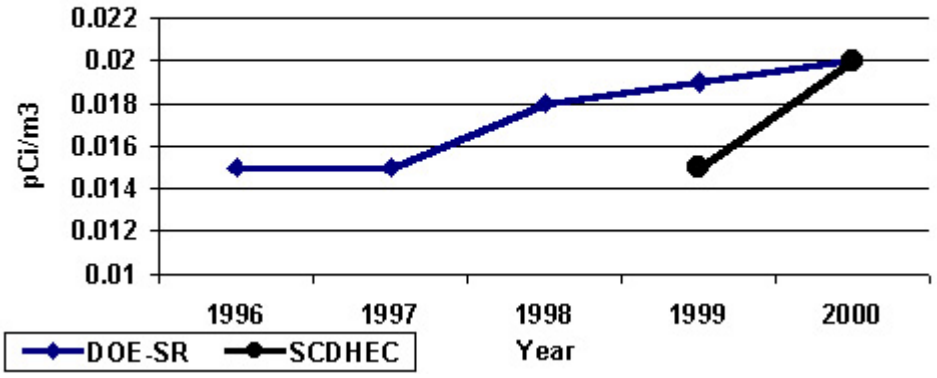


Figure 2. Average Ambient Beta/Gamma at the SRS Perimeter

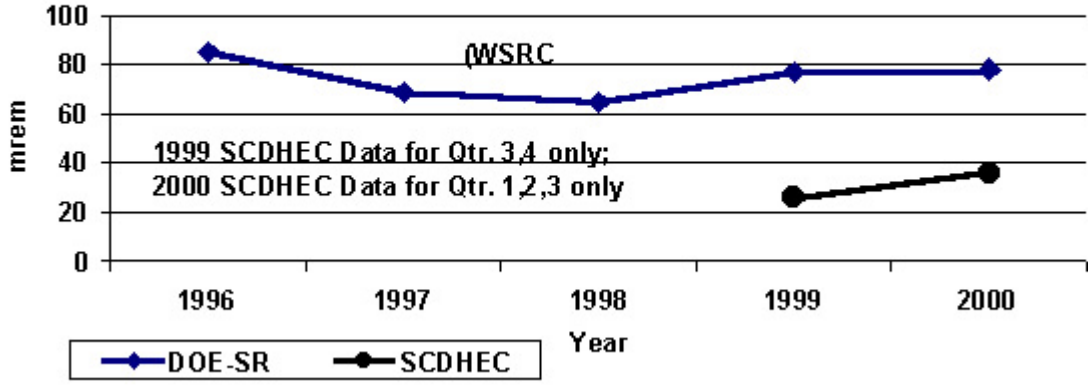
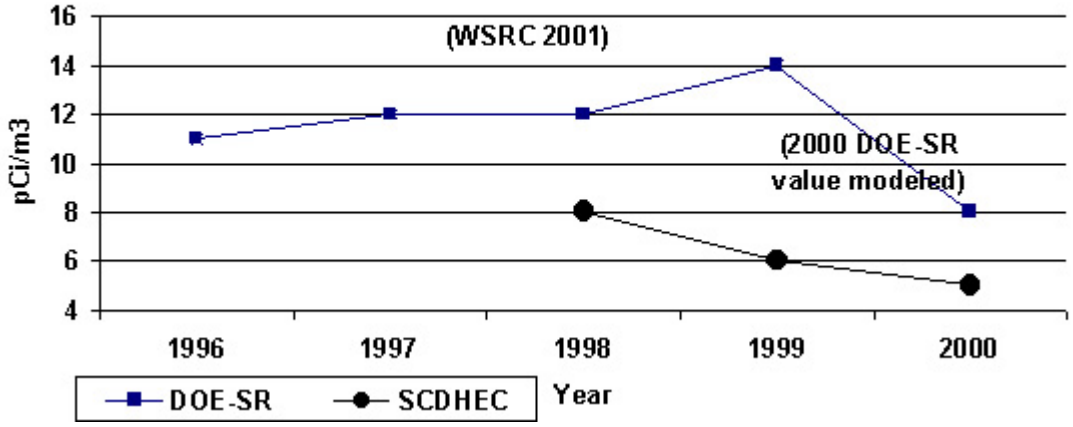
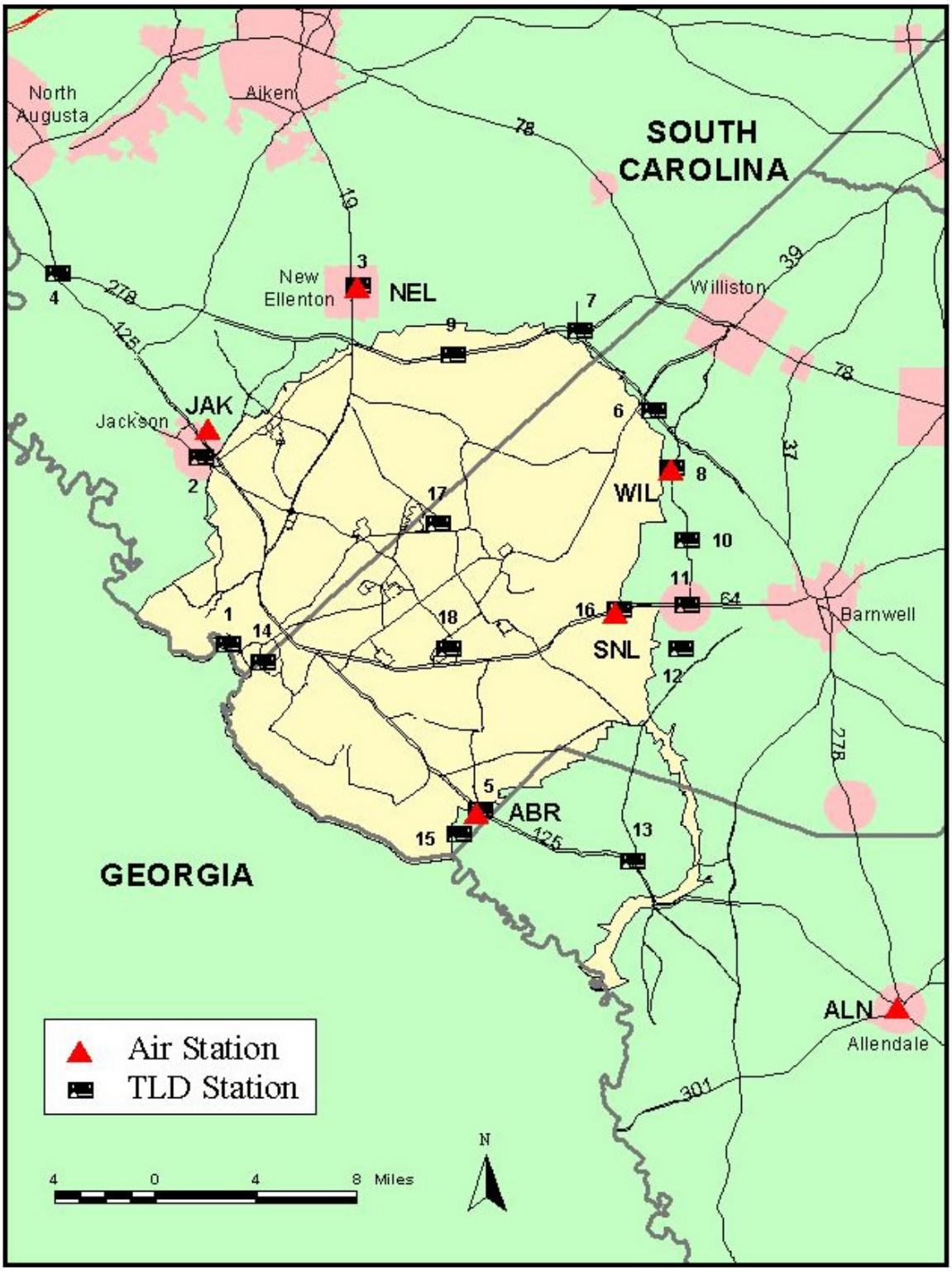



Figure 3. Average Atmospheric Tritium at the SRS Perimeter




In summary, no standards (specifically DOE Order 5400.5) were exceeded and there were no significant elevations of radiological pollutant concentrations associated with SRS operations at monitored locations. Sampling results by SCDHEC indicate that SRS activities did have a measurable but insignificant impact on local air quality.

Map 1. Radiological Atmospheric Monitoring Locations



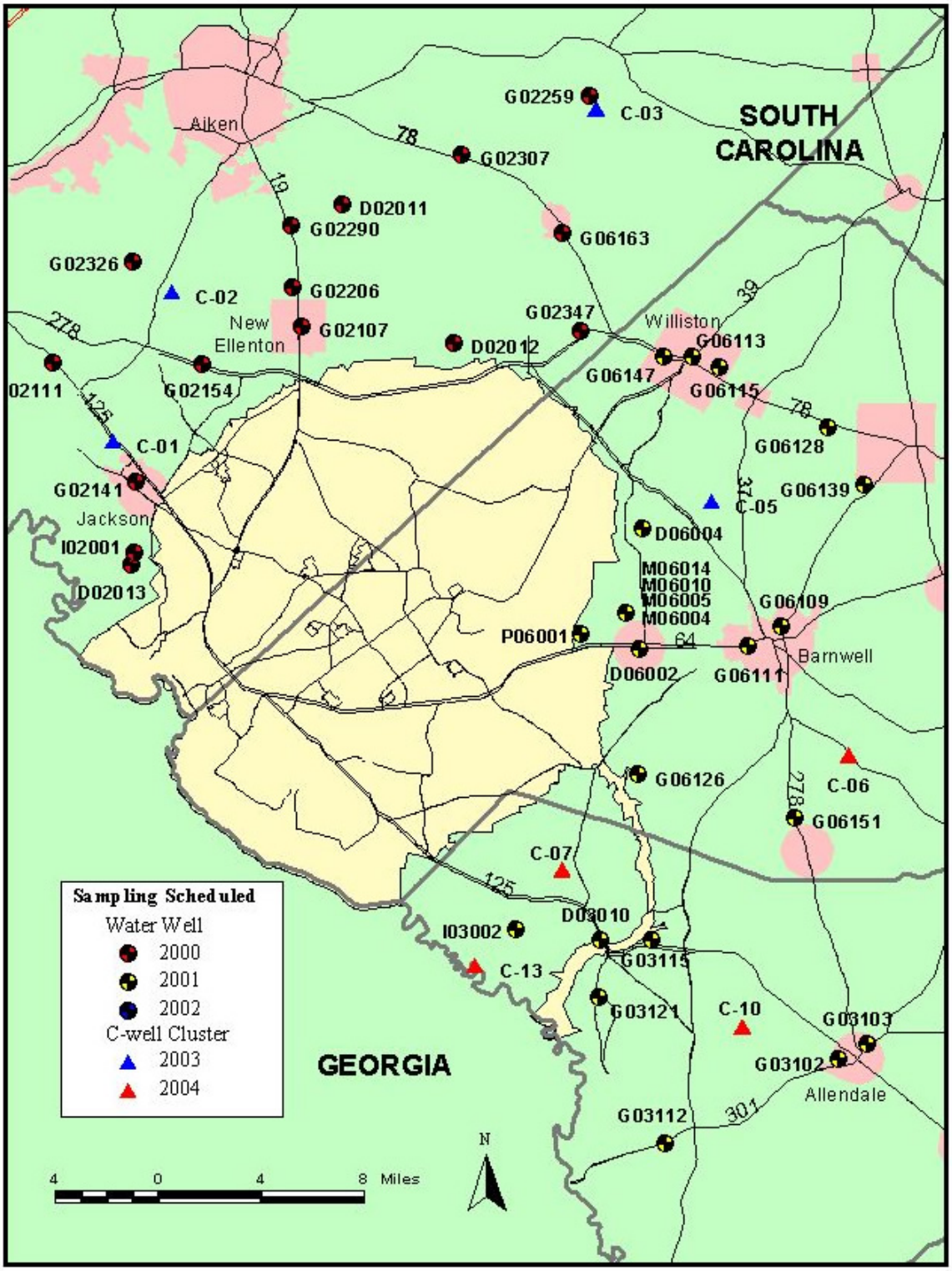
## Ambient Groundwater Quality Adjacent to SRS

The ESOP samples an ambient groundwater quality monitoring network adjacent to SRS in an effort to develop background water quality information and determine if contaminants have migrated off SRS. The ESOP Ambient Groundwater Monitoring Network is comprised of existing groundwater wells owned by various government agencies and members of the public.

The project objectives were to evaluate groundwater quality adjacent to SRS, compare results with historical data, determine any off-site contaminant migration, and expand current ambient water quality databases. The study area includes SRS and a 10-mile perimeter from the site boundary in South Carolina. ESOP evaluated five aquifer zones within the study area from the shallow water table to confined aquifers more than 1200 feet deep. The network wells are sampled on a five-year cycle. Fourteen wells from the northern side of the study area were sampled in 2000 **(Map 2).** ESOP analyzed filtered and non-filtered groundwater for basic water quality parameters, metals, tritium, and gamma-emitting radioisotopes. ESOP is also developing a Geographic Information Systems (GIS) database of water quality data and well information.

Based on a review of the analytical data **(Appendix B),** lead, a contaminant that does not appear to be associated with SRS activities, was present in two of the wells sampled. The United States Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCL) for lead was exceeded in both of these wells above the 5 ug/L Aaction level.≅ These levels are similar to the levels detected in previous years. The persistence of lead in these wells is most likely due to well construction material or formation chemistry interacting with the low pH waters in the northern half of the study area. ESOP samples from the drinking water systems associated with these wells did not indicate lead contamination. These wells will be re-evaluated during further sampling events and investigated by SCDHEC Bureau of Water staff.

Map 2. Ambient Groundwater Monitoring Network



## Drinking Water Quality Monitoring

The ESOP Drinking Water Monitoring Project (**Map 3**) evaluates drinking water quality to provide assurance to the public that man-made radiological constituents at levels exceeding regulatory limits have not impacted municipal drinking water systems adjacent to SRS. The project objectives are to collect monthly raw water composite samples from water treatment plants that use the lower reaches of the Savannah River as source water; to collect quarterly grab samples from selected municipal and large community drinking water systems within 30 miles of SRS, and to analyze samples for gross alpha, nonvolatile beta, gamma-emitting radionuclides, and tritium.

Prior to mid-1996, the DOE-SR sampled 19 water systems semi-annually for radiological constituents. This routine sampling included 16 groundwater fed systems and three surface water systems. In mid-1996 monitoring of the 16 groundwater systems was discontinued from the DOE-SR monitoring program. Since 1996, only the three systems that rely on surface water sources have been routinely sampled by DOE-SR.

The ESOP currently monitors community/municipal water systems for various contaminants, including radionuclides. SCDHEC requires monitoring for man-made and naturally occurring radionuclides for a minimum of four consecutive quarters during system start-up. Monitoring continues quarterly if the running average exceeds the EPA MCL. Monitoring is reduced to once every four years if activities are below the MCL. The ESOP supplements this monitoring by sampling selected systems in the vicinity of SRS quarterly, and collecting monthly composites of raw surface water from water treatment plants that use the lower reaches of the Savannah River.

The study area was established as a 30-mile radius circle centered in SRS. All public water systems in the study area were identified using the SCDHEC GIS. All of the municipal and large community systems within the study area were selected for sampling. Of the systems selected, 25 were groundwater fed and three were surface water fed systems. These systems serve approximately 236,000 customers with nearly 102,000 receiving their water from groundwater sources. Monthly and quarterly samples were labeled, preserved, and transferred to a laboratory with a chain-of-custody. Samples were submitted to the Lower Savannah District (LSD) Laboratory for tritium analysis. SCDHEC Radiological Environmental Monitoring (REMD) Laboratory conducted gamma spectroscopy, gross alpha, and gross nonvolatile beta analyses. All data collected was verified, validated, and stored in project files and spreadsheets (**Appendix C)**.

Tritium continues to be the most abundant radionuclide detected in public drinking water supplies potentially impacted by SRS. It was detected in both groundwater and surface water-fed systems. However, these tritium activities were well below the 20,000 pCi/L MCL **(Figure 4)**.

**Figure 4.**

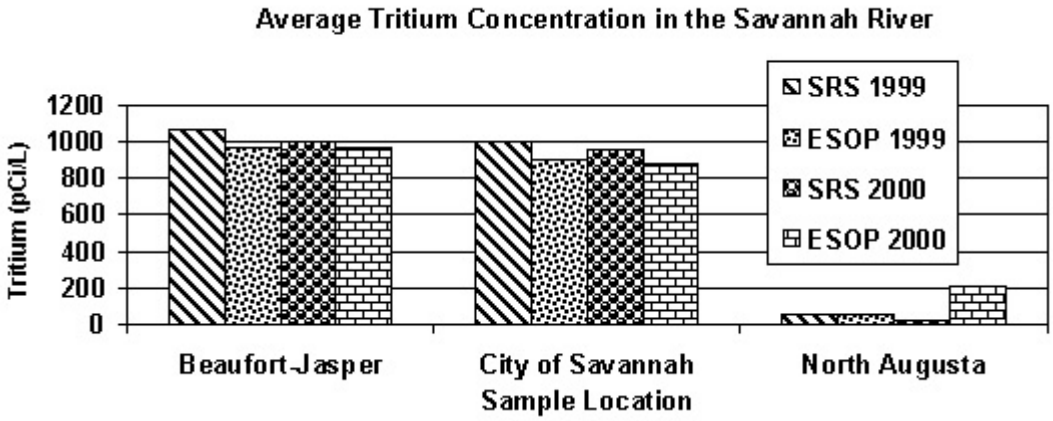
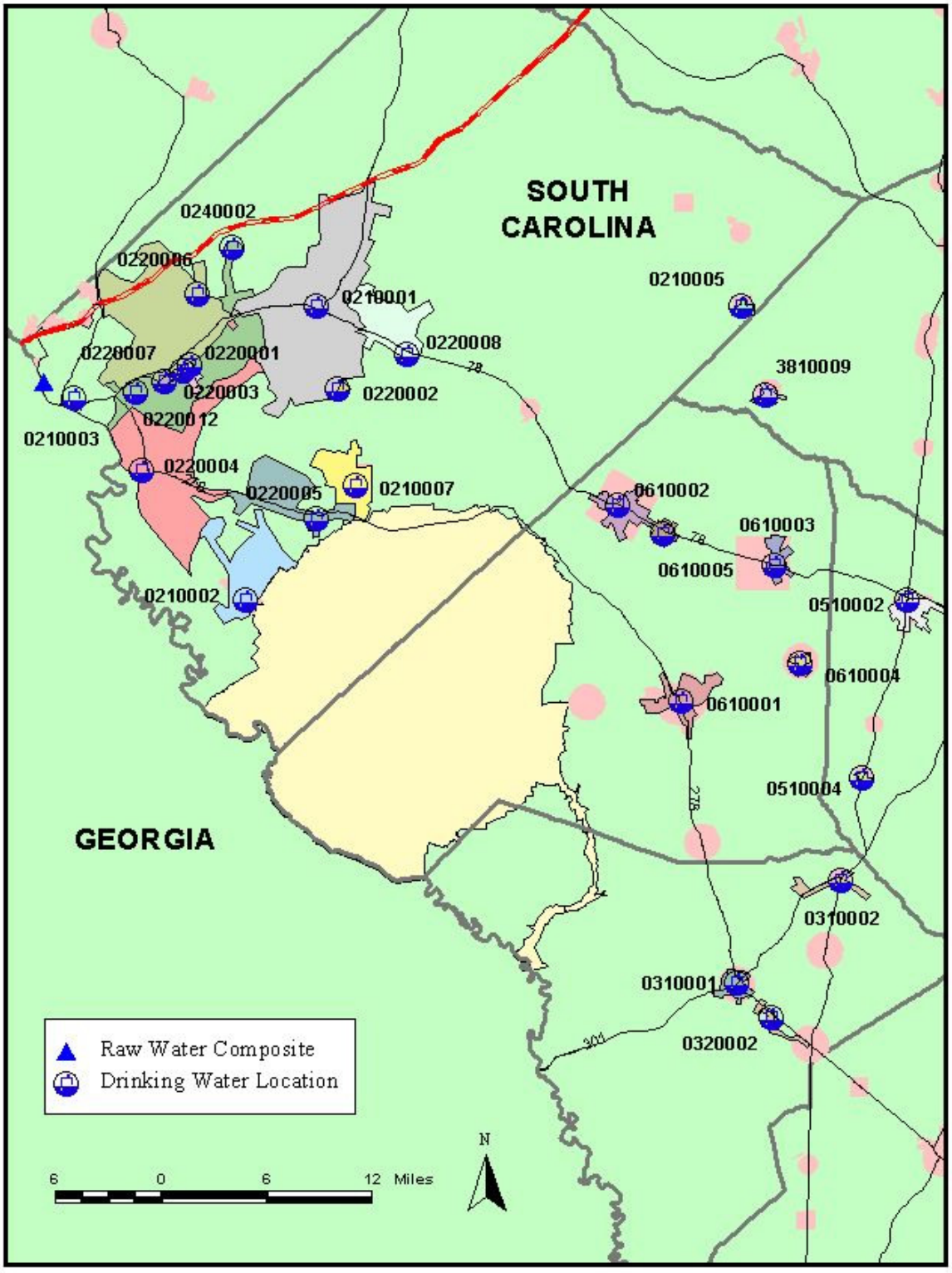



**Figure 4** compares the DOE-SR and ESOP average raw water tritium data from the three Drinking Water plant sampling locations on the Savannah River. Based on the DOE-SR sampling effort, they estimate that 5,420 curies of tritium were transported down the Savannah River in 2000. All data collected from the North Augusta water treatment facility during 1999 and 2000, for DOE-SR and ESOP were below the LLD.

Gross alpha, gross beta, and gamma-emitting radionuclides were not detected at activities above their respective MCLs. ESOP tritium data is consistent with DOE-SR data generated from three colocated systems.

Map 3. Drinking Water Monitoring Locations



## Radiological Surface Water and Sediment Surveillance

The Radiological Surface Water and Sediment Project has been collecting samples on and adjacent to the SRS since February 1997 **(Map 4).** This project monitors radiological surface water and sediments; compares results with historical SRS data; enhances surface water and sediment databases; monitors tritium activities on the SRS and in the Savannah River; and characterizes trends of radionuclides in streams and sediments associated with SRS. Information gathered from this project was used to compare to data collected by DOE-SR.

The enhanced surface water monitoring program provides downstream drinking water customers with advanced notice of an SRS release. The stream surveillance program monitors six streams– , Upper Three Runs at Highway 125, Beaver Dam Creek downstream from D-Area, Four Mile Creek below Highway 125, Pen Branch at Highway 125, Steel Creek at Highway 125, and Lower Three Runs (directly below PAR Pond Dam). ISCO® automatic samplers collect approximately 30 milliliters of stream water every 30 minutes. The ESOP personnel collect these composite samples every Monday, Wednesday, and Friday, with the exception of holidays. Samples were analyzed on the day of collection by the LSD laboratory. Results from the tritium analysis were used to project tritium activities in the Savannah River **(Appendix D).** There were no releases above expected activities that would warrant regulatory action during the 2000-sampling period.

The project is comprised of a total of 13 surface water locations and 15 sediment locations **(Map 4**). Surface water was collected three days per week from the six enhanced surface water locations and once a week from the remaining seven locations. The seven locations included Jackson boat landing, Four Mile Creek at Road C-7, TNX Boat Landing, Steel Creek boat landing, Little Hell boat landing, U.S. 301 Bridge, and Upper Three Runs at Road 2-1. Monthly composite samples from nine of these locations plus one duplicate location were analyzed for gross alpha, gross beta, and gamma-emitting radionuclides. In addition, stream water was collected once a month from five Savannah River creek mouths – Upper Three Runs at river mile 157.4, Beaver Dam Creek at river mile 152.3, Four Mile Creek at river mile 150.6, Steel Creek at river mile 141.8, and Lower Three Runs at river mile 129. These river locations were monitored for tritium.

Project reported data compared to DOE-SR reported data for tritium, cesium, uranium, gross alpha and gross beta-emitting radionuclides were within the same order-of-magnitude for most locations. Although there are slight differences that fall well within error regions of the reported values, ESOP and DOE-SR data is consistent with historically reported values**.**

Tritium activities were detected above the background levels at all sample locations (**Figures 5 & 6**). Four Mile Creek and Pen Branch continue to have the highest levels of tritium activities. ESOP data reported from samples collected from the mouth of Four Mile Creek (SV-2015) indicate that the public could be exposed to tritium activities greater than 20,000 pCi/L at that location. DOE-SR should consider monitoring at the mouth of Four Mile Creek. All public

access locations downstream from SRS were below the EPA MCL of 20,000 pCi/L.

**Figure 5.**

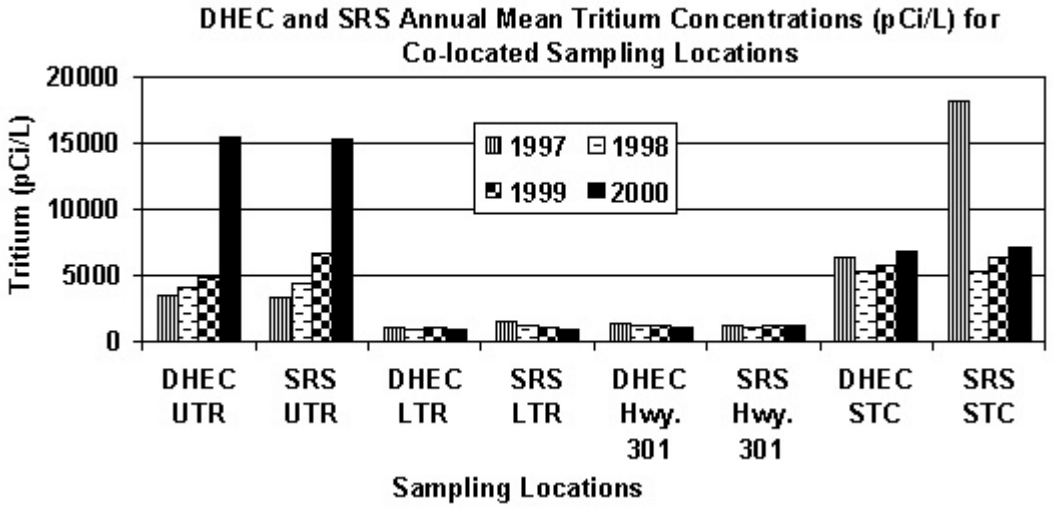
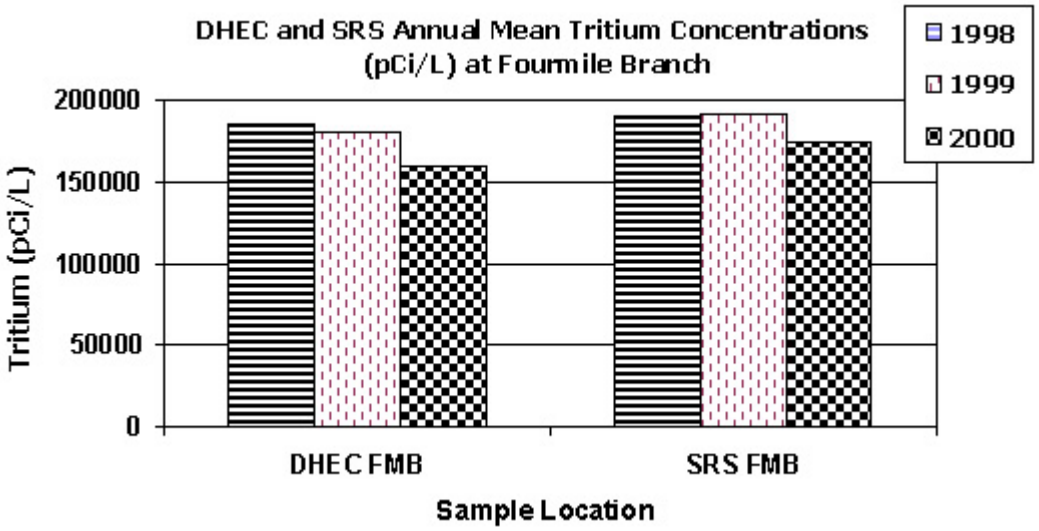


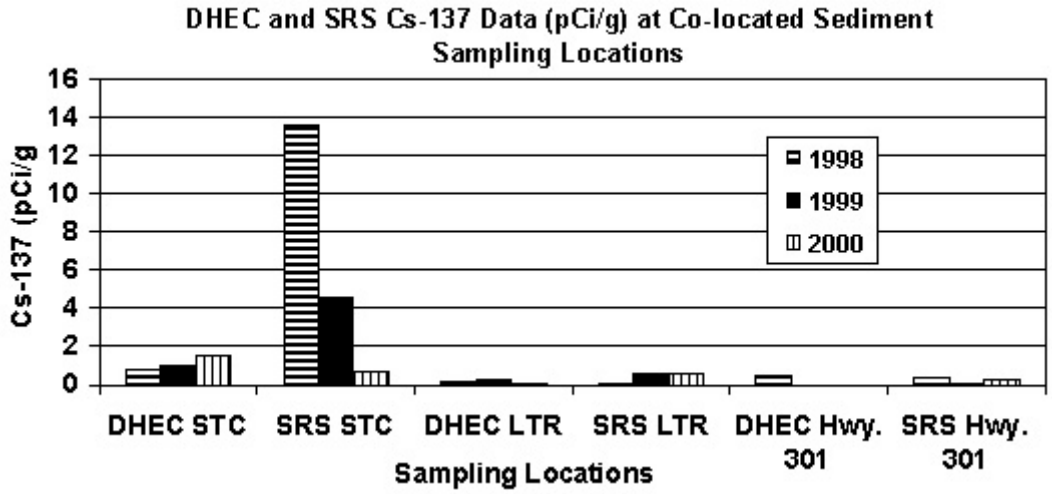

**Figure 6.**




Sediment samples were collected in May 2000 (**Figure 7**) and analyzed for gamma-emitting radionuclides. The variability of the 1998 Steel Creek data is within environmental parameters,

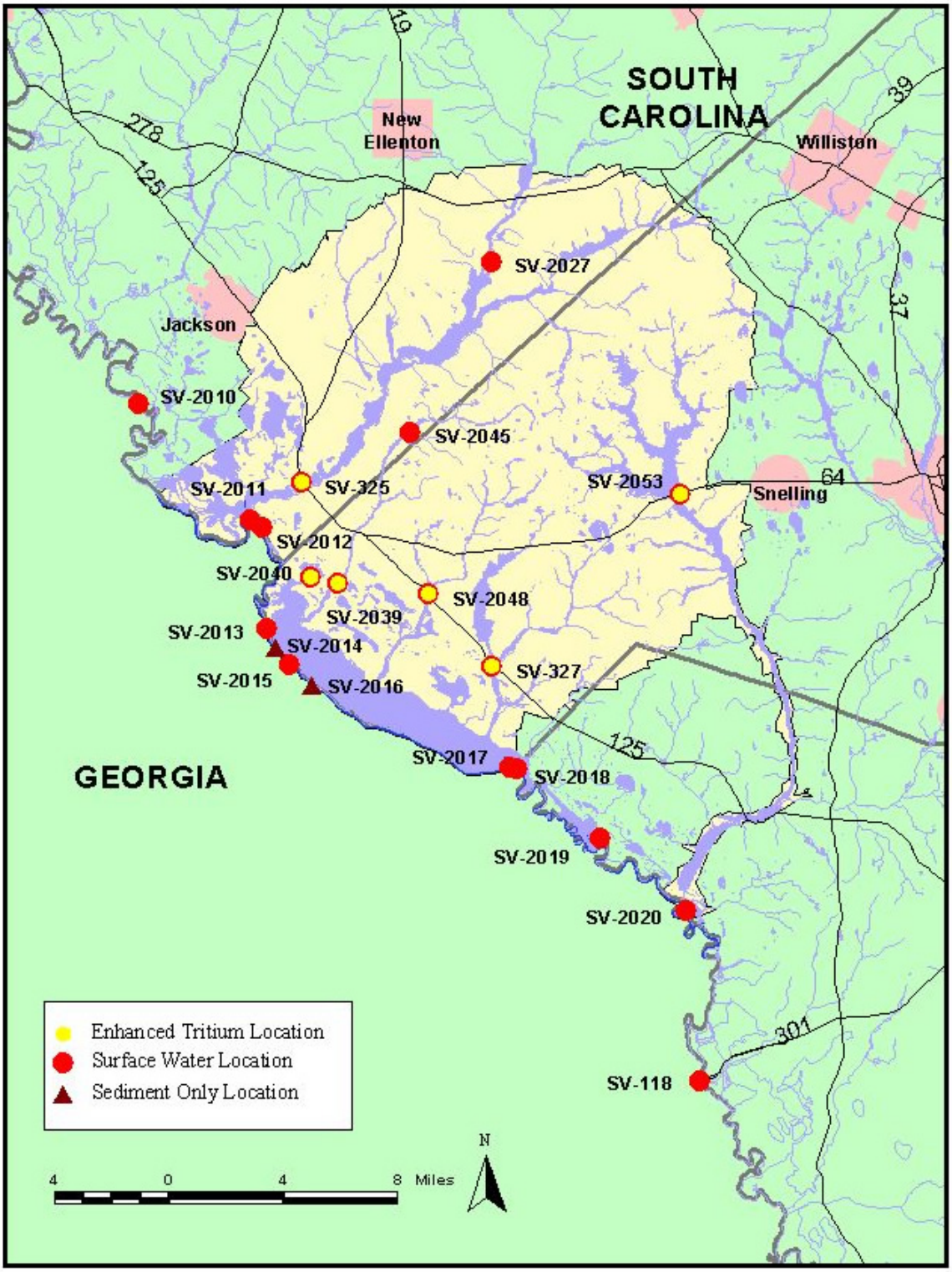
and is most likely due to inconsistent sample collection technique.

**Figure 7.**




ESOP will continue to independently monitor surface water and sediment as long as there are active missions at the SRS. Continued monitoring will provide an improved understanding of radionuclide activities in the surface water and Savannah River, and impart valuable information to human health exposure pathways. The comparison of data results allows for independent data verification for DOE-SR. This collaboration between DOE-SR and ESOP provides credibility and confidence in the information being provided to the public.

Map 4. Radiological Surface Water & Sediment Sample Locations



## Non-Radiological Surface Water and Sediment Monitoring

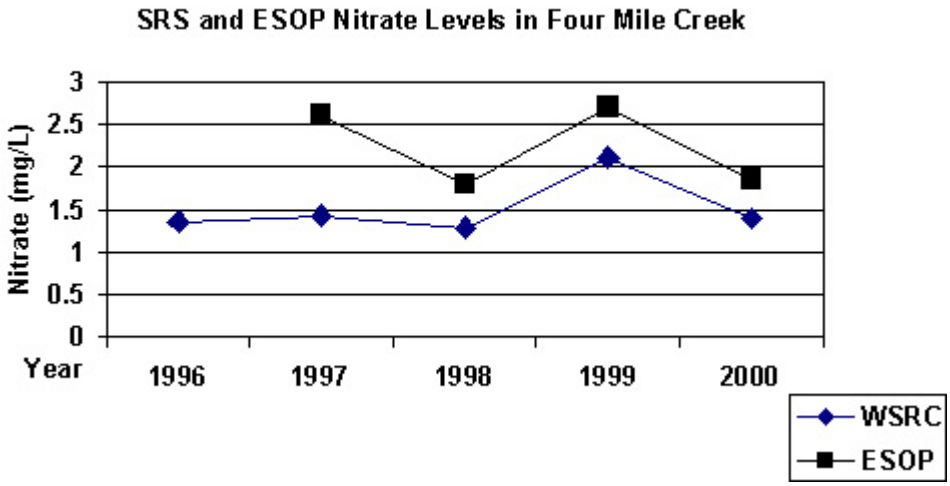
The streams located on the SRS receive treated wastewater and non-point source runoff from site facilities. Recent and historical data from SRS Environmental Reports indicate that the SRS waters are in accordance with Freshwaters Standard guidelines stated in the SCDHEC Water Classifications and Standards (Regulation 61-68), 1998.

The ESOP assessed the non-radiological sediment and surface water quality on SRS by sampling the on-site streams for inorganic and organic contaminants **(Map 5**). Specific parameters were analyzed monthly, quarterly, and annually. Sample sites were strategically chosen to monitor ambient sediment and surface water conditions to detect any non-radiological impact from DOE-SR operations.

Sediment data from this study, as well as 2000 DOE-SR sediment data, indicate no measurable impacts from DOE-SR operations **(Appendix E).** However, a comparison of SRS and ESOP sediment data could not be completed because of different methods used for analyzing sediments. SCDHEC recommends that SRS consider utilizing methods that quantify constituents found in the sediment. Currently, SRS utilizes the Toxicity Characteristic Leaching Procedure (TCLP) that quantifies the constituents in the leachate. By using alternative methods, SRS and ESOP will be able to more accurately compare data.

The overall non-radiological water quality on the SRS meets the Freshwaters Standard for South Carolina streams **(Appendix E).** All but two of the surface water parameters, nitrate and pH, continue to be within expected ranges for South Carolina streams. Nitrate concentrations from the Four Mile Creek (SV-326) sample location were higher than comparable South Carolina streams. These elevated nitrate concentrations possibly result from waste treatment facility discharge into Four Mile Creek upstream from this location (WSRC 2001a). Also, surface water pH from Upper Three Runs (SV-2027) sample location was lower than comparable South Carolina streams. Data from ESOP non-radiological surface water locations were compared to DOE-SR data where sample points were colocated **(Figure 8)**. The data from the colocated stations were similar for the parameters that were analyzed by both ESOP and DOE-SR. Future locations, numbers of samples, sample frequencies and monitoring parameters may change to maximize available resources and address project priorities.

**Figure 8**.


SRS and ESOP Nitrate Levels in Four Mile Creek
Nitrate (mg/L)
3
2.5
2
1.5
1
0.5
0
Year
1996
1997
1998
1999
2000
WSRC
ESOP

Map 5. Non-Radiological Surface Water & Sediment Sample Locations

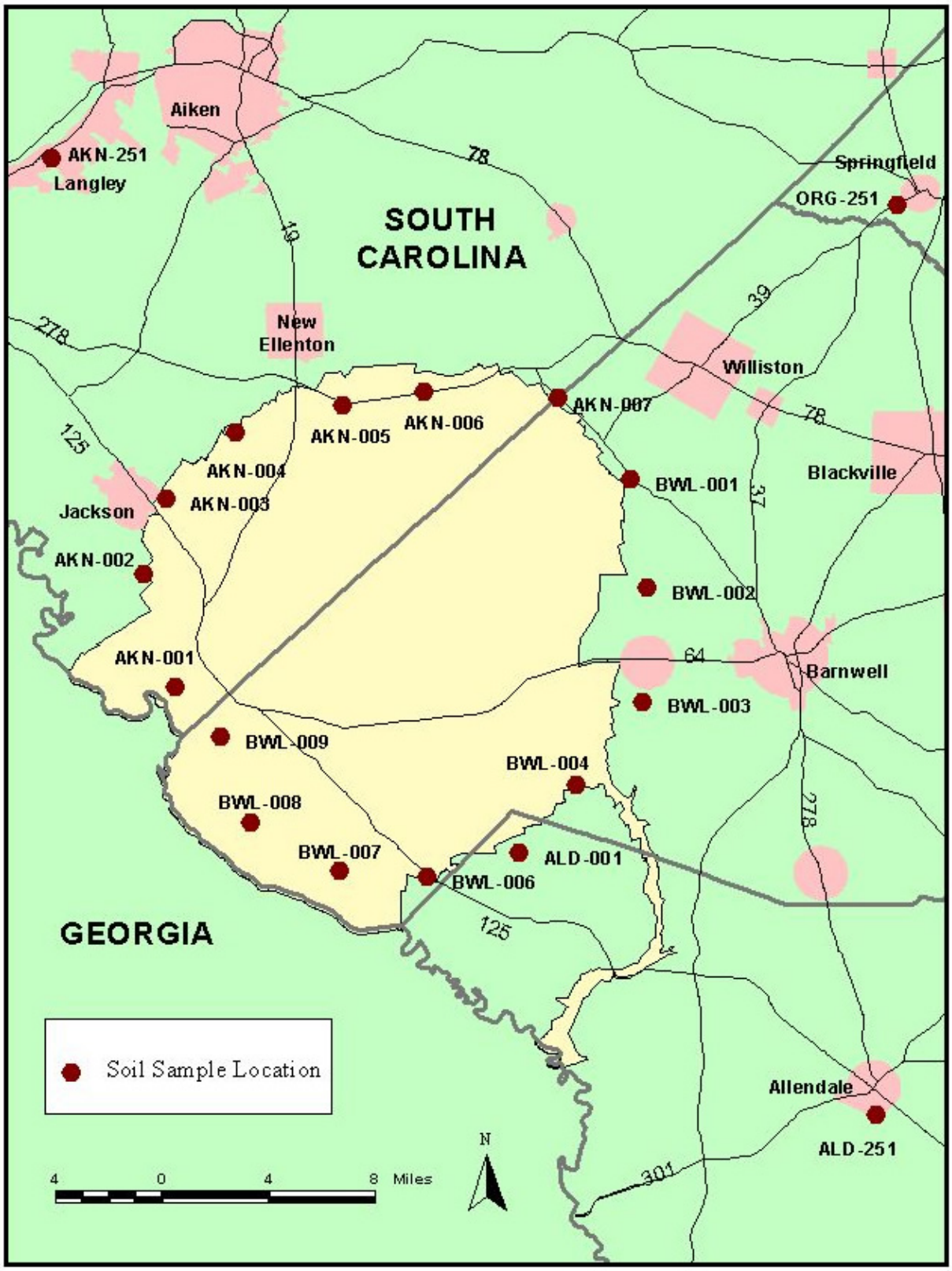
## Radiological Surveillance of Surface Soils On and Adjacent to SRS

The ESOP surface soil monitoring project evaluates surface soil radionuclide concentrations on and around the SRS. Westinghouse Savannah River Company soil monitoring was reduced from 24 sample locations in 1995 to six sample locations, currently. In FY 1999, ESOP soil samples were evaluated for gamma-emitting radionuclides. Since the FY 1999 soil sample results were low and consistent with background levels of gamma-emitting radionuclides, ESOP shifted the focus to Plutonium for FY 2000. All FY 2000 samples were analyzed for Plutonium (Pu)-238, -239, -240 by a contract laboratory.

ESOP surface soil monitoring locations have been configured to provide perimeter coverage of SRS at potential public exposure locations (**Map 6**). Soil monitoring is conducted at 22 locations: 16 locations around the perimeter of SRS; three locations 25 miles from the center of SRS (former DOE-SR environmental monitoring locations); two locations chosen at random from within a 50-mile radius of SRS; and a background location approximately 100 miles from SRS. Samples were collected from the surface to a depth of six inches during October and December of 2000.

Laboratory results (**Appendix F**) indicate that Plutonium-238 was not detected in any samples while activities for Plutonium-239, Plutonium-240 were either below the MDA or slightly greater than the respective MDA. No activity was measured above the Residential Soil Exposure Risk Based Activities (RBA) for Plutonium-238, 239, 240. Analytical results as compared to DOE-SR environmental monitoring data indicated that DOE-SR reported data is on the order of one to two magnitudes less than that reported by ESOP. One possible explanation for the difference could stem from differences in the MDAs from each laboratory. Additional research is being conducted to verify this explanation.

Map 6. Soil Monitoring Locations



## Radiological Monitoring of Terrestrial Vegetation On and Adjacent to SRS

The DOE-SR has historically collected and analyzed terrestrial vegetation, primarily Bermuda grass, on and around the SRS to determine concentrations of radionuclides. Sampling was discontinued at four 25-mile and three of four 100-mile stations in mid-1995. In 1996, the sampling frequency at locations outside the burial ground and the 14 SRS perimeter stations was reduced from quarterly to annually. In 1998, the number of on-site and perimeter stations was reduced from 100 to five. This sampling program remained constant for 2000**.**

The ESOP vegetation monitoring is designed to detect the presence of radionuclides in vegetation around the SRS that could stem from SRS operations (**Map 7**). The ESOP conducted independent vegetation monitoring in 2000 at 16 locations around the perimeter of the SRS; three former SRS monitoring locations 25 miles from the center of SRS; eight locations selected at random from within a 50-mile radius of SRS; and a background station approximately 110 miles from SRS. Sampling was performed in February, May, August, and November 2000.

Samples were analyzed for tritium activity and gamma-emitting radionuclides. Tritium was detected in vegetation at 17 of the 28 sites sampled in 2000. Four of the perimeter stations produced tritium levels greater than the LLD in all four sampling months. The stations with the highest detectable activity were generally located on the western and northern sides of the SRS, including vegetation collected near D-Area. This is possibly due to heavy water reprocessing and historical operations at that facility. Tritium was detected at one 25-mile station and one random 50-mile radius station, but not the 110-mile background station.

Vegetation was collected for gamma analysis in February, May, and August at the three 25-mile stations. One 25-mile and two randomly selected stations were sampled in November 2000. The perimeter stations were sampled on an alternating basis so that each station was sampled twice in 2000. Gamma-emitting radionuclides were detected in all samples (**Appendix G**). Cesium-137 (Cs-137) was detected at similar locations, especially at stations on the northern and southeastern sides of the SRS, as in 1998 and 1999**.**

ESOP data confirms historical DOE-SR conclusions that elevated tritium levels at the site perimeter are due to atmospheric tritium releases from SRS. Despite monitoring and analysis differences, tritium results from both programs at similar locations were all relatively low or below detection limits (**Figure 9**). The one colocation produced no detectable tritium from either program. Results for the colocation were similar for cesium-137 (**Figure 10).** To facilitate comparisons, ESOP recommends that DOE-SR modify its reporting format for tritium, either to picocuries/milliliter, or as picocuries/gram of fresh vegetation (i.e. wet weight). ESOP also recommends that a full list of radionuclides detected in SRS analyses be reported in the annual SRS Environmental Data report.

**Figure 9.**

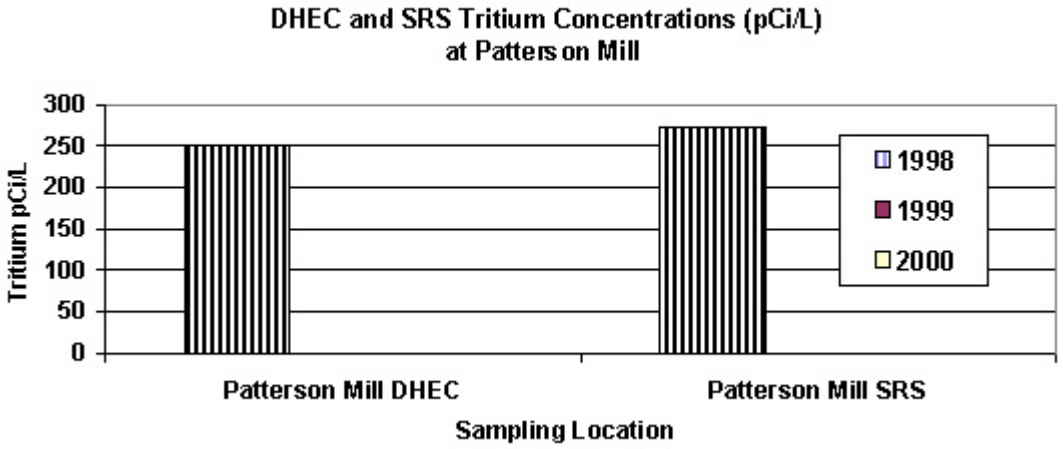
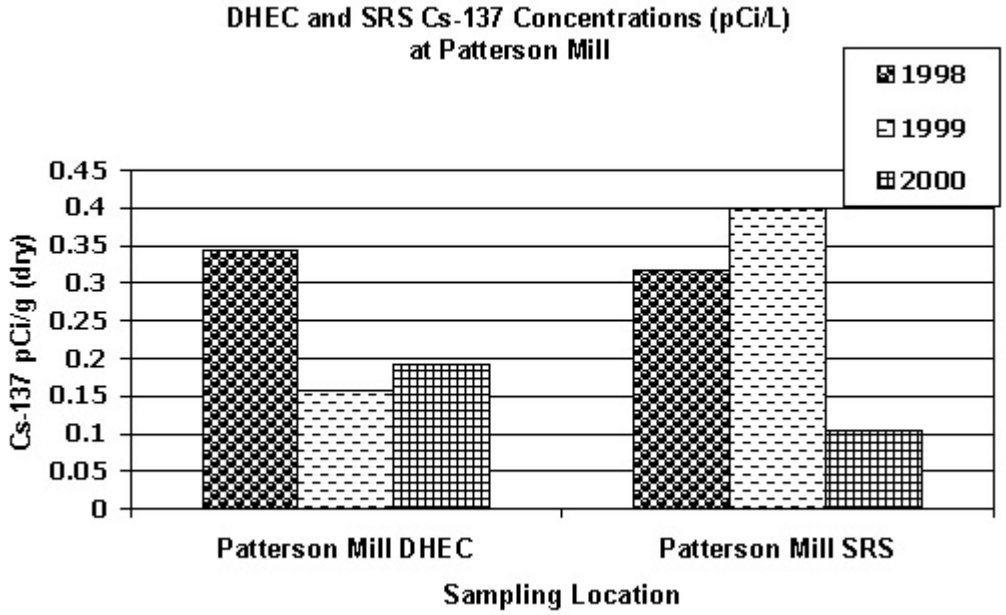
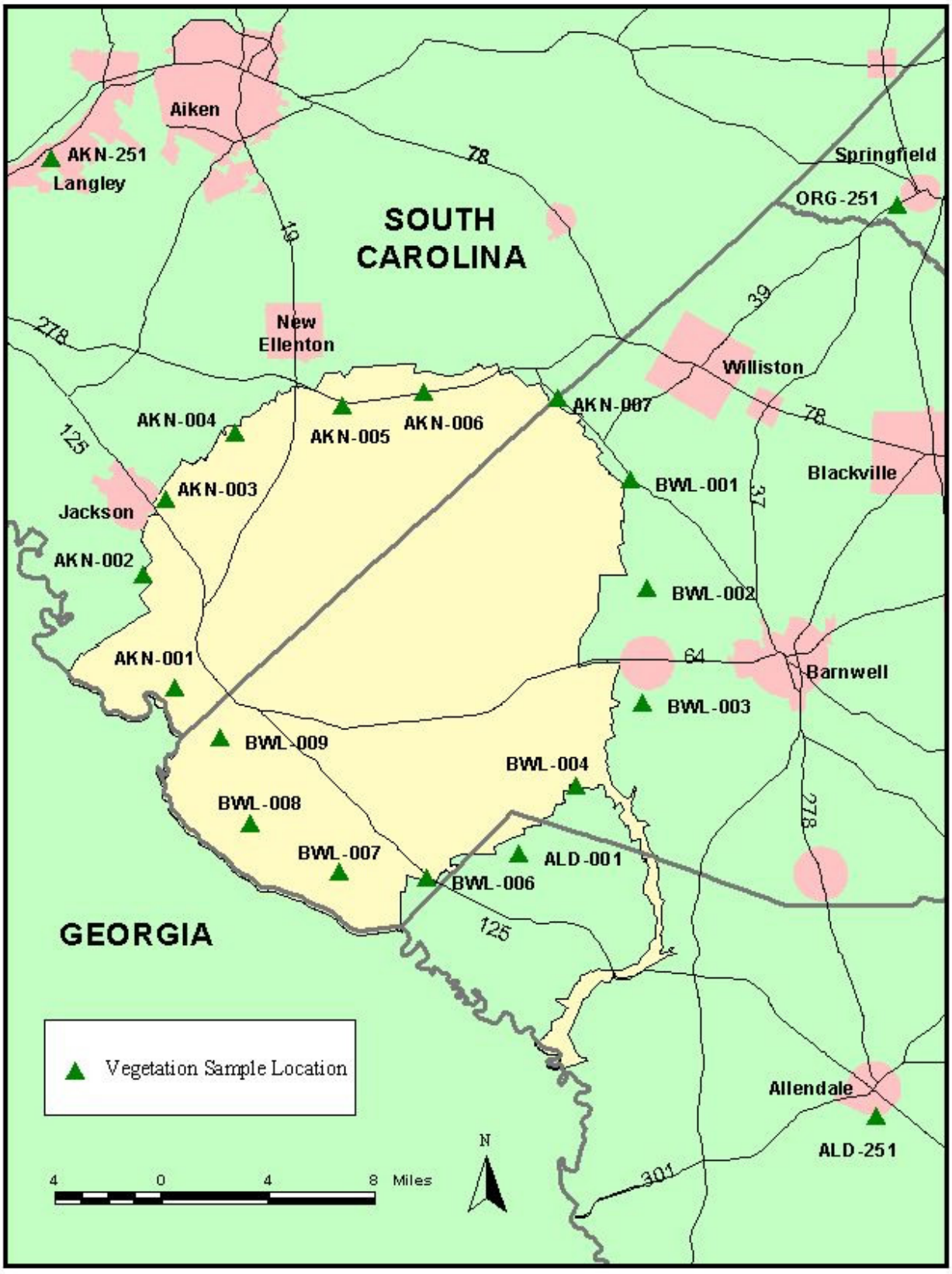

DHEC and SRS Tritium Concentrations (pCi/L)
at Patterson Mill
Tritium pCi/L
300
250
200
150
100
50
0
1998
1999
2000
Patterson Mill DHEC
Patterson Mill SRS
Sampling Location

**Figure 10.**


DHEC and SRS Cs-137 Concentrations (pCi/L)
at Patterson Mill
Cs-137 pCi/g (dry)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1998
1999
2000
Patterson Mill DHEC
Patterson Mill SRS
Sampling Location

Map 7. Radiological Vegetation Monitoring Locations

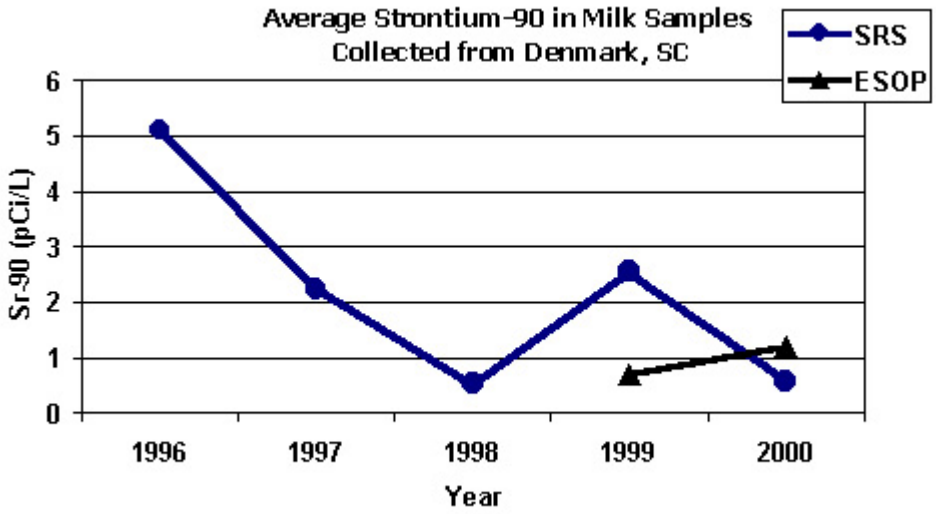


## Radiological Monitoring of Dairy Milk

Consumption of milk and other food products containing radioactive materials can be a source of human exposure to radioactivity. Dairy milk can become contaminated through atmospheric deposition of radioactive particles on grass and plants ingested by cows, and transferred to milk. The pathway via milk is of particular importance in the case of infants and children. While they more likely to drink large quantities of milk, they are also actively developing bones and teeth. Strontium, a calcium analogue, can bio–accumulate in bones and teeth displacing the calcium. Since dairy milk is an important pathway for human exposure to radioactivity, milk samples from dairies around SRS are routinely analyzed for levels of radioactivity that could impact human health.

The DOE-SR has historically conducted monitoring around SRS to determine concentrations of certain radionuclides in dairy milk. Due to a change in the scope of production activities at SRS, only five of the 17 sampling locations remain active (WSRC 2001). In 2000, ESOP personnel performed dairy milk sampling at seven locations on a monthly basis (**Map 8**). Results from this monitoring provide data on concentrations of radionuclides in milk within a 50-mile radius of SRS and a basis of comparison with SRS data. Quality Assurance and Quality Control measures were performed in accordance with established standard operating procedures concerning the collection and evaluation of milk. The samples were analyzed for tritium and select beta-gamma emitters. Low levels of tritium were detected above the LLD in three samples. Strontium-90 was detected slightly above the MDL in nine samples. Cesium-137 was also detected in one milk sample. These detections could be due to past site operations. In addition, low levels of potassium-40, a naturally occurring radionuclide, were detected in all milk samples (**Appendix H**).
An evaluation of the analytical results (**Figure 11**) indicates consistency between the ESOP and DOE-SR programs for 2000. However, the results are limited in scope because the current required reporting method used by the DOE-SR utilizes values below MDLs (U.S. DOE 1991)

**Figure 11.**



Map 8. Radiological Dairy Milk Monitoring Locations

## An Analytical Comparison of Sediment Samples at Creek Plantation

The Savannah River swamp is periodically flooded due to large amounts of rainfall over the Savannah River basin. During these events, streams containing various radioisotopes from SRS flow directly across Creek Plantation. On March 2, 2000, nine sediment samples were collected from Creek Plantation by the Environmental Monitoring Section (EMS) of the SRS. An ESOP representative assisted the EMS sampling team with the sample collection. The purpose of this exercise was to split samples between the two groups for Cs-137 analytical comparison. The results from three of the four split samples analyzed by SCDHEC REMD and SRS EMS all had a relative percent difference of less than 10, and were within the same order of magnitude **(Appendix I)**. This project can serve as a source of verification for the results generated from samples collected on March 2, 2000, as well as demonstrating the importance of collecting split samples between the two agencies.

## Radiological Fish Monitoring Associated with the Savannah River Site

Due to public concerns of increased risk to human health associated with the consumption of Savannah River fish, SCDHEC monitoring of radionuclide concentrations in fish continues in an effort to determine the magnitude, extent, and trends of radionuclide concentrations. The DOE-SR also conducts fish monitoring to assess the effects of routine and accidental releases of radionuclides and other contaminants. The 1995 U.S. EPA guidance document and data concerning radionuclide concentrations in fish were used to evaluate the DOE-SR Radiological Fish Monitoring Program. Largemouth bass and channel catfish were used as the target species. A third group, sunfish, was collected during 2000. Sunfish are sampled every fifth year of collection. This data is used to increase the database for evaluating the DOE-SR program. The collected species are consumed in the study area and among the catch of local anglers. EPA studies have shown that these species bioaccumulate measurable amounts of radionuclides.

Five fish for each species, bass and catfish, were collected from 10 sample locations (**Map 9**). Five sunfish species were collected from six sample locations. Fish were collected using boat mounted electrofishing equipment. Samples were collected at five stations where creeks from the SRS meet the Savannah River. In addition, samples were collected at one station above the SRS, two stations below the SRS, and two background locations. All fish were composited by species and sample location, and separated into edible and non-edible homogeneous portions. Composites were analyzed for gamma-emitting isotopes and tritium. Non-edible bass and catfish composites collected from stations adjacent to the SRS were analyzed for strontium-90.

Project reported data was compared to DOE-SR reported information (**Figures 12 – 19**, **Appendix J**). Compared tritium, Cs-137, and strontium-90 data was not similar for several locations. Discrepancies in these results could be attributed to the natural variation of radionuclide concentrations. Although there are differences between reported values, the data is consistent with historically reported data. ESOP and DOE-SR will continue to investigate these differences. Samples have been collected and split between ESOP and DOE-SR for analyses. No discrepancies in the data results were found. This would potentially rule out methodology differences and conclude that the discrepancy is with different samples being analyzed between the two programs. Independent monitoring of radionuclide concentrations in Savannah River fish will continue along with evaluating the DOE-SR Radiological Fish Monitoring Program. Project information will be available for the SCDHEC Bureau of Water, and the Health Hazard Evaluation Division to further evaluate potential human health risk associated with the consumption of Savannah River fish. The information provided will also help in advising, informing, and protecting the people at risk, and in comparing current and historical data.

**Figure 12.**

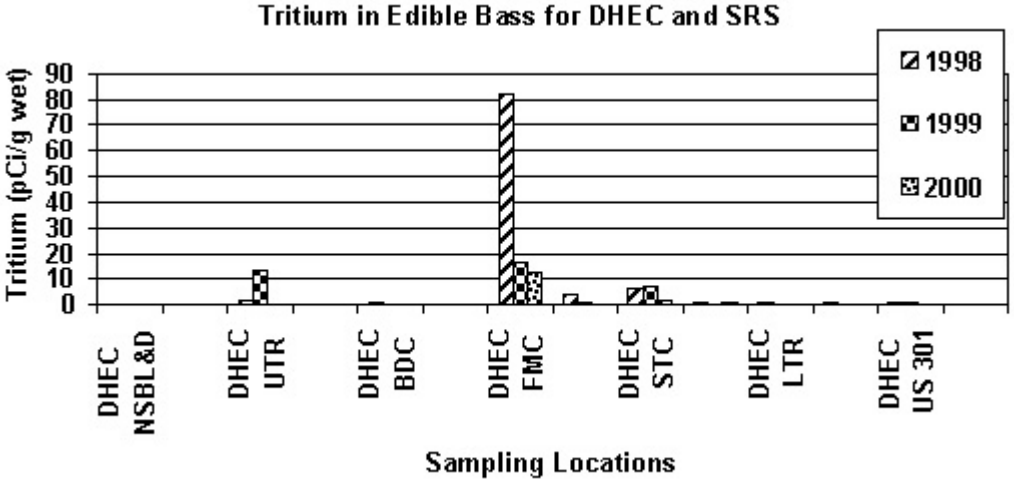



**Figure 13.**

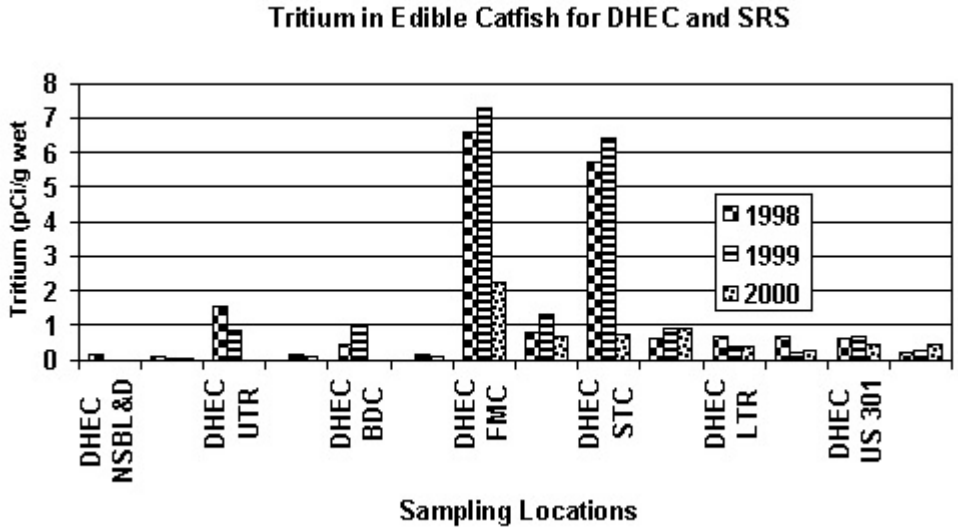



**Figure 14.**

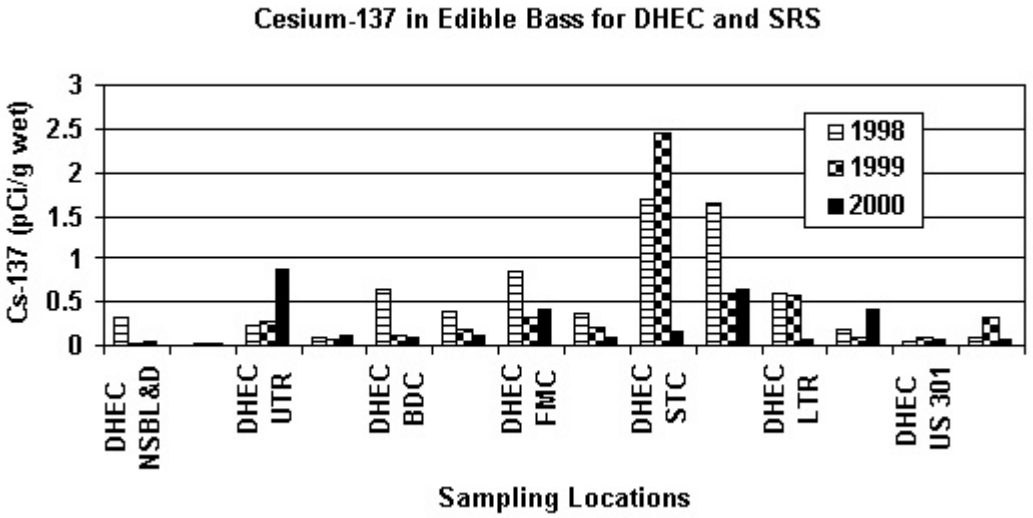



**Figure 15.**

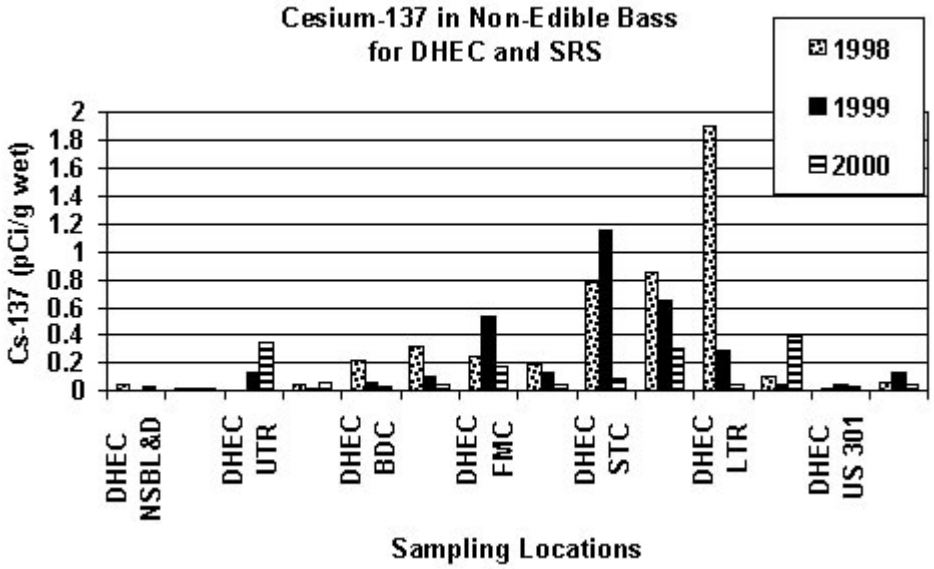



**Figure 16.**

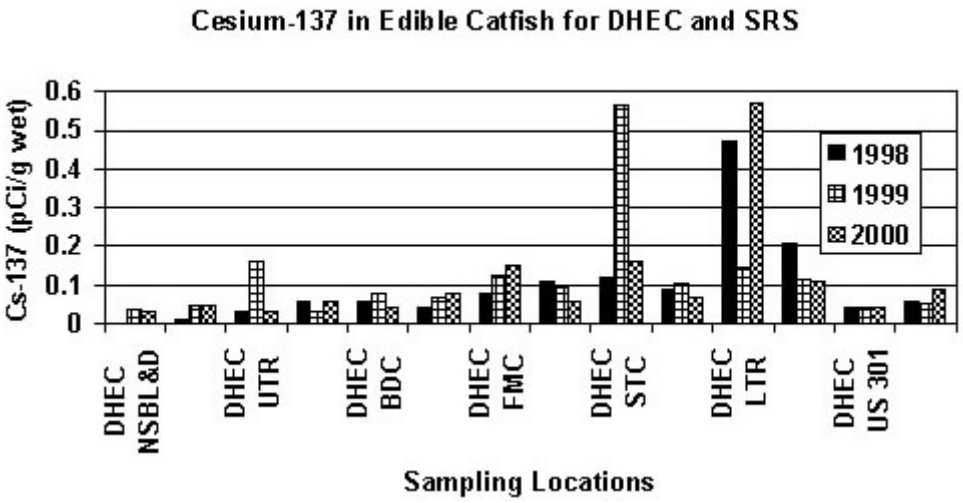



**Figure 17.**

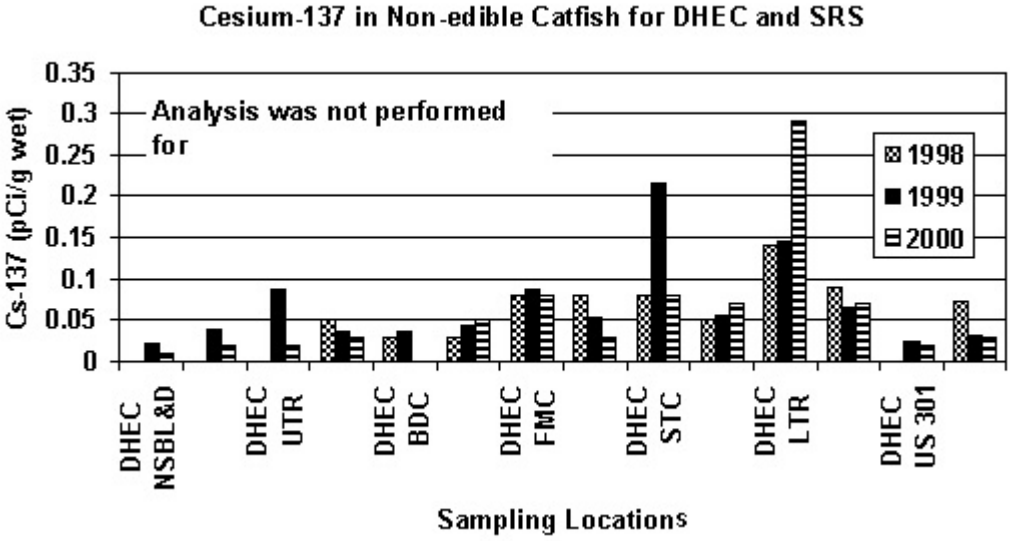



**Figure 18.**

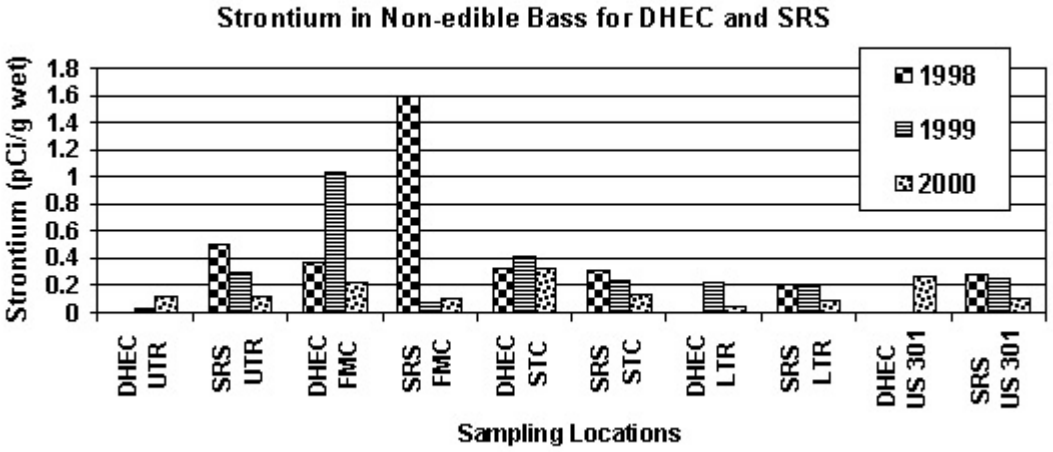
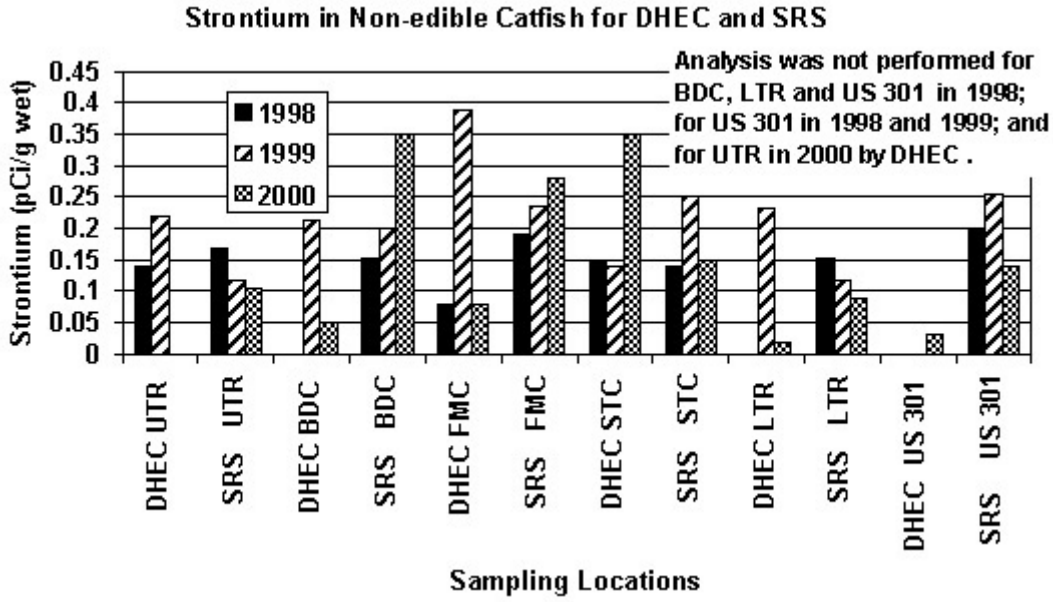

Strontium in Non-edible Bass for DHEC and SRS
Strontium (pCi/g wet)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1998
1999
2000
DHEC UTR
SRS UTR
DHEC FMC
SRS FMC
DHEC STC
SRS STC
DHEC LTR
SRS LTR
DHEC US 301
SRS US 301
Sampling Locations

**Figure 19.**


Strontium in Non-edible Catfish for DHEC and SRS
Strontium (pCi/g wet)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1998
1999
2000
Analysis was not performed for BDC, LTR and US 301 in 1998; for US 301 in 1998 and 1999; and for UTR in 2000 by DHEC .
DHEC UTR
SRS UTR
DHEC BDC
SRS BDC
DHEC FMC
SRS FMC
DHEC STC
SRS STC
DHEC LTR
SRS LTR
DHEC US 301
SRS US 301
Sampling Locations

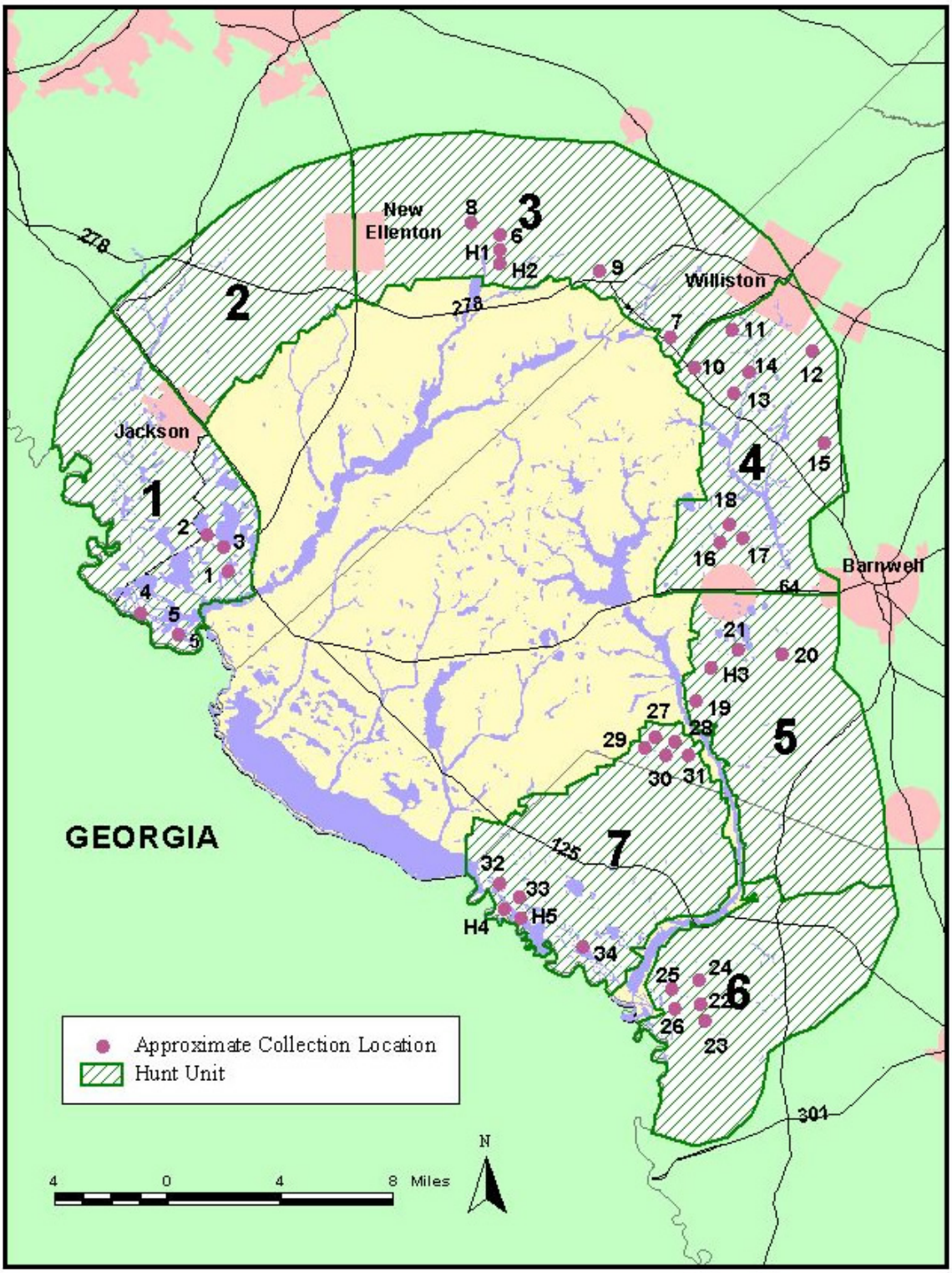
Map 9. Radiological Fish Monitoring Locations

## Radiological Game Animal Monitoring Adjacent to SRS

Routine and accidental releases from SRS to the environment may directly affect game animal populations and their food sources. Consumption of wildlife species can result in the transfer of contaminants to humans, such that the 30-year projected risk (3.6E-04) for the off-site hunter is greater than all other standard pathways combined. The radionuclide of concern in this project is Cs-137 because of its relatively long physical half-life (30 years) and its availability to game animals and associated health risk to humans.

The ESOP has initiated a game animal monitoring project to address concerns of potentially contaminated white-tailed deer and feral hogs migrating off SRS, by analyzing samples collected off-site. In 2000, SCDHEC analyzed muscle tissue from 34 deer and five hogs for Cs-137 from a five-mile study area adjacent to the SRS (**Map 10**). Six tissue samples were also collected and analyzed from a background location 50 miles northeast of the SRS. Study area and background data were similar, with a slightly higher mean Cs-137 concentration in deer from the study area samples (**Appendix K**). Cs-137 data ranged from 0.03 to 6.89 picocuries per gram (pCi/g) for deer and 0.12 to 1.50 pCi/g for feral hogs within the five-mile study area adjacent to the SRS. Cs-137 data ranged from 0.25 to 1.28 pCi/g for deer a 50-mile background location.

Map 10. Radiological Game Monitoring Locations



## Oversight Monitoring and Support Activities

The objectives of the ESOP Oversight Monitoring Support Projects were to: conduct document review; establish contacts concerning each sampling activity; acquire, validate, and report discrepancies in data; provide oversight of sampling activities; and conduct split soil sampling. ESOP evaluated a total of 6 sites in 2000. All sites included the acquisition of split soil samples and the oversight of field activities from selected sample locations. These split soil samples were shipped to the SCDHEC Analytical Services Laboratory for analysis of metals, volatiles, pesticides, and herbicides as per EPA SW-846 methodology (**Appendix L**). One site's (C-Area Railroad) samples were sent to the SCDHEC Radiological Environmental Monitoring Laboratory (REMD) for analysis of select beta-gamma emitting radionuclides.

Summaries of FFA sites

! M-Area Sandblast, CMM-008

The Sandblast Area, CMM-008 is an area of concern listed in Appendix G.1 of the FFA. This area is located in M-Area of the SRS. The M-Area Sandblast, CMM-008 was used for sandblasting of metal items. Sandblasting at SRS was performed to remove paint and corrosion from metal objects. The primary objective of the sampling activities was to evaluate the potential impact to surrounding soil due to operations at this site. Soil samples were collected by DOE-SR personnel and analyzed for TAL. ESOP personnel split soil samples from 3 locations and the samples were also analyzed for TAL by the SCDHEC ASD laboratory. Analytical results compared favorably between the SCDHEC and DOE.

! M-Area Sandblast, CMM-002, CMM-003

The Sandblast Areas, CMM-002 and CMM-003 are located in M-Area of the SRS. This area contained several above ground storage tanks. The sandblasting performed at these areas consisted of paint removal from the storage tanks. Soil samples were collected by DOE-SR personnel and analyzed by an on-site laboratory. ESOP personnel split soil samples from 4 locations and the samples were analyzed for TAL by the SCDHEC ASD laboratory. Analytical results compared favorably between the SCDHEC and DOE.

! C-Area Railroad

The C-Area Cask Car Abandoned Railroad Tracks are located in the C-Area Reactor confines of the SRS. The objective of the sampling was to verify that no significant activity of radionuclides persisted in the soils surrounding the C-Area railroad tracks. Soil samples were collected by DOE-SR personnel and analyzed. ESOP personnel split soil samples at 6 locations and had the samples analyzed by gamma spectroscopy from the SCDHEC REM laboratory. All results were within the same order of magnitude between SCDHEC and DOE.

! ECOD N-2

The Early Construction Operation Disposal Site (ECODs) is located near N-Area. The ECOD N-2 was used for the disposal of construction debris and other waste materials during construction and early operations at SRS. Soil samples were collected by DOE-SR personnel and analyzed. ESOP personnel split soil samples from 4 locations and the samples were analyzed for TAL, TCL, and pesticides by the SCDHEC ASD laboratory. All analytical results have not been received to date.

! N-Area Miscellaneous Rubble Pile (MSRP)

The N-Area Miscellaneous Rubble Pile is located near N-Area. The MSRP was used for the disposal of various types of solid waste. The primary objective of the soil sampling was to determine if past disposal practices had adversely impacted the surrounding soils. Soil samples were collected by DOE-SR personnel and analyzed. ESOP personnel split soil samples from 6 locations and had the samples analyzed for TAL by the SCDHEC ASD laboratory. Analytical results compared favorably between the SCDHEC and DOE.

! B-Area Sandblast, CMB-001 (HWCTR)

The B-Area Sandblast, CMB-001 is located in the B-Area of the SRS. The Sandblast Area surrounds the former HWCTR reactor test facility and contains 3 discharge ditches. Soil samples were collected by DOE-SR personnel and analyzed by an on-site laboratory. ESOP personnel split soil samples form 5 locations and had the samples analyzed for TAL and TCL by the SCDHEC by the SCDHEC ASD laboratory. All analytical results have not been received to date.

Map 11. Oversight Monitoring and Support Locations